VESI- JA YMPÄRISTÖHALLITUKSEN
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WATER POLLUTION PROBLEMS IN THE FINNISH AND SWEDISH PULP AND PAPER INDUSTRIES

PRIORITIES AND MANAGEMENT OPTIONS IN FUTURE POLLUTION CONTROL WORK

V E S I- J A Y M P Ä R I S T Ö H A L L I T U K S E N
M O N I S T E S A R J A

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PRIORITIES AND MANAGEMENT OPTIONS IN FUTURE POLLUTION CONTROL WORK

Committee for the Gulf of Botnia
Report of the special working group

Vesi- ja ympäristöhallitus
Helsinki 1988

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BACKGROUND

At the yearly meeting of 1985, the Committee for the Gulf of Bothnia decided to set up a working group between Sweden and Finland for water pollution activities in the pulp and paper industry. The work has been organized by a directive group and the basic material has been handled in project groups.

When the working group was formed, the Finnish and Swedish industries were asked if they wished to participate in its activities.

The members of the directive group responsible for this report are: Runo Savisaari and Seppo Ruonala from the Finnish National Board of Waters and Environment, Ulla-Britta Fallenius from the Swedish National Environmental Protection Board, Rurik Skogman and Pertti Laine, representing the Finnish pulp and paper industry, and Karl Fredrik Gustafsson and Roland Lövblad representing Swedish pulp and paper industry. The material has been prepared by Kalle Noukka, the Finnish National Board of Waters and Environment and Gun Sannholm, the Swedish National Environmental Protection Board.

The directive group has earlier given a status report "Water Pollution Problems of Pulp and Paper Industries in Finland and Sweden". In this memorandum, the representatives of the authorities give an account of the priorities and management options in future pollution control work in Finland and Sweden as regards discharges of effluents of the pulp and paper industry. The directive group has also instructed two working groups to prepare material concerning the coordination of the monitoring of discharges and receiving waters in Finland and Sweden. These matters are dealt with in separate reports.

The directive group considers that its task has thus been fulfilled.

Introduction

Despite considerable efforts to reduce pollution, the pulp and paper industry still imposes a considerable pollutant load on the receiving waters. The situation was noted early by both the industry itself and the pollution control authorities. In chapter 1 in the report "Water Pollution Problems in the Pulp and Paper Industries in Finland and Sweden", the discharges of easily degradable organic substances are shown to have decreased since the mid-fifties. In spite of the extensive measures taken to improve the situation the pulp and paper industries are still, however, the major source of these organic discharges.

Since the end of the seventies, environmental management, especially in SWEDEN, has been increasingly concentrated on slowly degradable and/or bioaccumulating substances. This means that such effluents as the discharges from bleacheries have become the focus of attention of both the industry and the authorities. The pollutant substances discussed in this connection are chlorinated organic compounds. In addition, more consideration will be paid to the problems presented by chemicals, and demands should be made for a reduction in the discharges of nutrients.

In FINLAND the necessary measures are determined on the basis of the waters receiving the discharges and the condition of these waters.

The measures selected are those that will give optimal benefit. At the same time special importance is attached to the reduction of toxic substances and prevention of occasional discharges with acute effects.

A major aim is to favour production processes and methods which give a low waste load. External biological treatment has, however, proved to be an effective

complement in many respects.

As far as possible, specific solutions are sought for individual plants and general routine solutions are avoided.

According to the National Board of Waters and Environment, the following measures are required:

- Reduction of biologically easily degradable organic substances with the aim of minimizing oxygen depletion and also acute toxicity, unpleasant smells and tastes and aesthetic deterioration.

- Reduction of biologically slowly degradable organic substances with the aim of minimizing toxicity, accumulation and colour.

- Reduction of the nutrient load with the aim of minimizing eutrophication.

In FINLAND it is hoped that these results will be obtained with the high-efficiency external treatment plants completed and under construction. These expectations appear justified, since the most commonly used activated sludge treatment plants have proved remarkably effective in dealing with chlorinated organic substances and other slowly degradable material. It is not yet considered possible to set definite limits for chlorinated compounds, as these cannot be clearly defined and standard analysis and monitoring methods remain to be developed.

CHEMICAL PULPING

The chief part of the discharges to the Baltic Sea/the Gulf of Bothnia from chemical pulping comes from the kraft pulp mills. The following text thus mainly concerns the kraft pulping process. The main principles can be applied, however, in sulphi-

te pulp mills, though the technical solutions required for these vary greatly (Chapter 2.5 in the report "Water Pollution Problems in Pulp and Paper Industries in Finland and Sweden").

The discharges of dissolved organic substances from the production of unbleached pulp have lately been diminished by the adoption of more efficient washing plants, condensate treatment systems, and collection of accidental spills. Furthermore, fibre losses have been reduced by the use of more closed recirculation systems and external sedimentation basins. In consequence, the effects of this type of discharge on the receiving waters are probably mostly restricted to the vicinity of the mill, where, however, they may be considerable.

In both Finland and Sweden it is considered that every mill should reduce its discharges from the production of unbleached pulp by at least the following internal measures:

* adoption of dry debarking
* well-closed water recirculation systems
* efficient washing machinery
* well constructed system for the recovery of accidental spills
* treatment of condensates by steam stripping and reuse in the process or, alternatively, biological treatment of the condensates.

External treatment by biological methods or chemical precipitation may be necessary to safequard the condition of the receiving waters, e.g. when the capacity of these waters is limited or when a rise in production would otherwise increase the waste load.

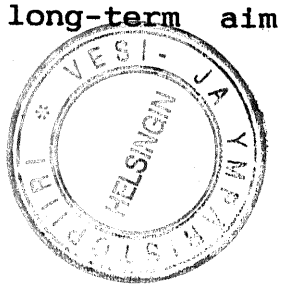
The production of bleached pulp makes the greatest contribution of COD, BOD_7, nutrients, toxic substances, and chlorinated organic substances to the effluents of the pulp and paper industry. As regards discharges from existing bleach

plants for pulp, the priorities and management options differ between the two countries.

In FINLAND the water pollution control measures completed or under development will considerably diminish the discharges of both easily degradable and more stable organic substances. In the near future emphasis will be laid on the toxicity, the total amount of organic substances, and the nutrient content of the effluents. Later as it becomes technically and economically feasible, the aim will be to eliminate chlorinated organic substances, since the threats posed by these substances should be minimized.

In its plan of action against marine pollution the National Environmental Protection Board in SWEDEN has stressed that efforts should primarily be directed at stable substances that have a serious toxic effect, and can accumulate in the food chains. Several of these substances belong to the group of chlorinated organic substances and should naturally be given priority. The Environmental Protection Board has pointed out that measures to reduce discharges of chlorinated organic substances are urgent and should be started in all Swedish mills within the next five years. The Board further claims that, in view of the risks posed by stable organic poisons in the environment, the measures cited above are not sufficient. The Board considers that complementary measures to virtually eliminate discharges of chlorinated organic substances should have come into use by about the year 2010.

To make possible the reduction and future elimination of discharges of chlorinated organic substances, it is considered in both Finland and Sweden that two main lines can be followed: internal measures within the process and external measures. A combination of these measures will probably prove necessary to achieve the goal. The long-term aim is a process



with closed water circulation, in which the dissolved substances are recovered and burned.

To achieve the goal, in a technically/economically correct way internal measures should be applied as far as possible. The following measures should currently be introduced.

* Process control (e.g. control of the Kappa number and residual chlorine)
* Extended cooking and/or oxygen bleaching to reduce the Kappa number before bleaching
* Efficient washing of pulp before bleaching
* Replacement of chlorine with other bleaching chemicals, currently chiefly chlorine dioxide
* Addition of oxygen or peroxide in the extraction stage.

Within a reasonable period, these internal measures should be complemented with pretreatment of pulp, to achieve a pre-bleaching kappa number allowing, if possible, bleaching without chlorine.

The external treatment methods currently in use are aerated lagoons, and, especially in Finland, activated sludge plants for the total effluent. These treatments reduce oxygen-consuming substances and substances toxic to fish. As regards the contents of chlorinated organic substances in the effluent, the aerated lagoon removes only the compounds of low molecular weight, which represent about 20-30 % of the total chlorinated organic substance. According to Finnish experience, treatment in an activated sludge plant reduces BOD by over 90 % and both COD and chlorinated organic substances by over 50 %.

Although advanced internal measures are employed, external treatment methods may still be needed as a final stage for the whole effluent, or parts of it to reach an acceptable situation concerning slowly degradable organic substances, nutrients, etc. It may be necessary to develop process and

treatment technologies for this purpose. If the effluent volumes can be radically diminished by internal measures, the external measures can be so designed that they effectively dispose of the remaining discharges. The most promising methods are some kind of biological treatment, with bacteria cultures adapted to the effluent, possibly in combination with chemical precipitation.

MECHANICAL PULPING

The effluent from chemi mechanical pulping contains large amounts of biologically oxygen-consuming substances and is also very toxic.

The effluent should therefore be treated effectively both as regards the content of organic impurities and the toxic compounds. The methods available at present are anaerobic and aerobic treatments and chemical precipitation.

According to the Environmental Protection Board in SWEDEN, these methods do not give entirely satisfactory results in respect of either discharges of organic substances or toxic compounds. To reach a satisfactory solution development inputs are needed, for example in order to:

* return process streams to the chemical cycle when possible
* develop further the biological treatment techniques
* develop new purification techniques.

The effluents from other kinds of mechanical pulps should, depending on the effluent volumes, the situation in the receiving waters, etc., be subjected to biological treatment and/or chemical precipitation.

PAPER MAKING

The effluents from paper making vary greatly in character, depending on the raw materials, chemicals used, end product and degree of integration.

The volume of the paper making effluent should be minimized by internal measures. As a final treatment stage in unintegrated paper mills, chemical precipitation should normally be used in order, for example, to reduce discharges of residual chemicals, possibly in combination with biological treatment if the state of the receiving waters so requires.

BOARD MAKING

The effluent from board making contains dissolved organic substances released from the wood. The amount released depends on the conditions during fiberization.

The discharges should be reduced, partly by internal measures partly by external treatment. The internal measures include suitable conditions during fiberization, increased recirculation of process water and evaporation of process water. The external treatments should include sedimentation and, depending on the state of the receiving waters, biological treatment, possibly in combination with chemical precipitation.

THE USE OF CHEMICALS

The pulp and paper industry, especially paper mills, use large number and amounts of auxiliary chemicals and dyestuffs. The chemicals used should be easily degradable and cause no harm to the biota. Some of the chemicals currently in use are slowly degradable and toxic to living organisms.

The discharge permits, issued in FINLAND demand that the industries report the chemicals used each year. According

to a general requirement, the chemicals used should cause as little harm to the environment as possible. The authorities use the reports to check that the terms of the discharge permits are followed. The forthcoming legislation on chemicals can be expected to increase knowledge of the effects of chemicals on the environment and to influence attitudes concerning the use of chemicals.

In SWEDEN the companies report on the chemicals that they use in connection with the applications made in conformity with the environmental protection law. Possible changes in the use of chemicals are announced in yearly reports. Together with the county administration, the companies are required to go through the use of chemicals, striving to replace chemicals posing risks to the environment with less dangerous ones. The companies are asked to produce documentation when this is lacking.

As regards the introduction of new chemicals, the Swedish Environmental Protection Board has a restrictive attitude. New chemicals are not permitted before test results (biological and chemical) are available that show the chemical or its products of degradation to have no undesirable effects on the environment.

FUTURE RESEARCH

The threat posed by the effluents of the pulp and paper industry is still serious and effective measures to cope with it must be taken without delay. The effects of certain types of effluents are still incompletely known. To some extent, effective technical solutions are lacking, e.g. as concerns the effluents from bleacheries. For this reason, considerable resources are needed for technical research and research concerning the chemical composition of bleaching effluents and their biological effects.